

# Geologic Resource Evaluation Scoping Summary Tumacacori National Historic Park, Arizona

Geologic Resources Division  
National Park Service  
US Department of the Interior



The Geologic Resource Evaluation (GRE) Program provides each of 270 identified natural area National Park Service units with a geologic scoping meeting, a digital geologic map, and a geologic resource evaluation report. Geologic scoping meetings generate an evaluation of the adequacy of existing geologic maps for resource management, provide an opportunity for discussion of park-specific geologic management issues and, if possible, include a site visit with local experts. The purpose of these meetings is to identify geologic mapping coverage and needs, distinctive geologic processes and features, resource management issues, and potential monitoring and research needs. Outcomes of this scoping process are a scoping summary (this report), a digital geologic map, and a geologic resource evaluation report.

The National Park Service held a GRE scoping meeting for Tumacacori National Historic Park (TUMA) on April 4, 2006, at the NPS Saguaro National Park Fire Offices. Stephanie O'Meara (CSU) facilitated the discussion of map coverage and Sid Covington (NPS GRD) led the discussion regarding geologic processes and features at the park. Participants at the meeting included NPS staff from the park, Geologic Resources Division, and Sonoran Desert Network and cooperators from the Arizona Geological Survey (AZGS), Arizona State Parks, the University of Arizona, and Colorado State University (CSU) (see table 2). This scoping summary highlights the GRE scoping meeting for Tumacacori National Historic Park including the geologic setting, the plan for providing a digital geologic map, a prioritized list of geologic resource management issues, a description of significant geologic features and processes, lists of recommendations and action items, and a record of meeting participants.

## Park and Geologic Setting

Tumacacori National Historic Park, located north of Nogales in the Santa Cruz River valley, was established as a National Monument on September 15, 1908, and was designated a National Historic Park on August 6, 1990 (Public Law 101-344). On August 21, 2002, an additional 310 acres of land were added to the park through the Tumacacori National Historic Park Boundary Revision Act of 2002 (P.L. 107-218). The 360.32-acre park contains three separate units: the San Jose de Tumacacori mission, the Los Santos Angeles de Guevavi mission, and the San Cayetano de Calabazas mission. The San Jose de Tumacacori and Los Santos Angeles de Guevavi, established in 1691, are the two oldest missions in Arizona. The San Cayetano de Calabazas mission was established in 1756.

## Geologic Mapping for Tumacacori National Historic Park

During the scoping meeting Stephanie O'Meara (CSU) showed some of the main features of the GRE Programs digital geologic maps, which reproduce all aspects of paper maps, including notes, legend, and cross sections, with the added benefit of GIS compatibility. The NPS GRE Geology-GIS Geodatabase Data Model incorporates the standards of digital map creation set for the GRE Program. Staff members digitize maps or convert digital data to the GRE digital geologic map

model using ESRI ArcMap software. Final digital geologic map products include data in geodatabase, shapefile, and coverage format, layer files, FGDC-compliant metadata, and a Windows HelpFile that captures ancillary map data.

When possible, the GRE program provides large scale (1:24,000) digital geologic map coverage for each park's area of interest, which is often composed of the 7.5-minute quadrangles that contain park lands (figure 1). Maps of this scale (and larger) are useful to resource management because they capture most geologic features of interest and are positionally accurate within 40 feet. The process of selecting maps for management use begins with the identification of existing geologic maps and mapping needs in vicinity of the park. Scoping session participants then select appropriate source maps for the digital geologic data to be derived by GRE staff.

Map coverage for Tumacacori NHP consists of two quadrangles of interest: Tubac (Tumacacori unit) and Rio Rico (Guevavi and Galabazas units). These quadrangles lie within the Sells and Nogales 30' x 60' sheet (figure 1). Table 1 lists the source maps chosen for Tumacacori NHP.

**Table 1. GRE Mapping Plan for Tumacacori National Historic Park**

Covered Quadrangles	GMAP <sup>1</sup>	Citation	Scale	Format	Assessment	GRE Action
Rio Rico	1487	Simons, F.S. 1974. Geologic map and sections of the Nogales and Lochiel quadrangles, Santa Cruz County, Arizona. U.S. Geological Survey, Map I-762, 1:48000 scale.	1: 48,000	paper	Map includes Rio Rico quadrangle, which covers the Guevavi and Calabazas units	Digitization of paper map to the GRE geodatabase format; the GRE will only digitize the Rio Rico quadrangle portion of the source map, which covers in extent the Guevavi and Calabazas units of the park; will integrate into either FY06 or FY07 projects
Tubac	7467	Youberg, Ann and Helmick, W.R, 2001, Surficial Geology and Geologic Hazards of the Amado-Tubac Area, Santa Cruz and Pima Counties, Arizona, Arizona Geological Survey Digital Geologic Map 13 (DGM-13), 1:24,000 scale.	1: 24,000	digital	Map covers in extent the Tumacacori unit of the park;	Conversion of digital data to geodatabase data model; will integrate into either FY06 or FY07 projects

<sup>1</sup>GMAP numbers are unique identification codes used in the GRE database.

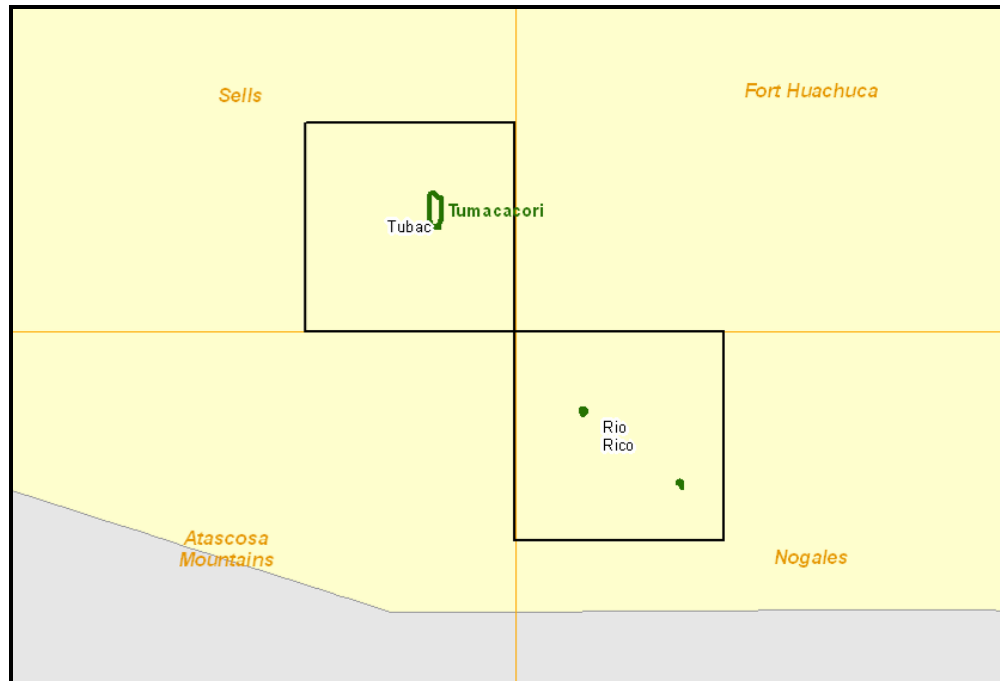


Figure 1. Quadrangles of Interest for Tumacacori National Historic Park, Arizona. The 7.5-minute quadrangles (scale 1:24,000) are labeled in black; names in yellow indicate 30-minute by 60-minute quadrangles (scale 1:100,000). Green outlines indicate monument boundaries.

Stephanie O'Meara (CSU) will work with the AZGS to acquire AZGS DGM-13.

Jeremy Moss (NPS TUMA) explained that most of Tumacacori's geology is recent and surficial. The park's focus is on soils and surficial deposits so they need to have a better understanding of soil ages and the distribution of surficial deposits, alluvial fans, and debris flows that reach the park from the slopes of the Tumacacori Mountains. He would like maps of these features. If possible, he would also like maps of the old channels that are visible within the present floodplain. Some of this information is available in aerial photographs.

Phil Pearthree of the Arizona Geological Survey (AZGS) noted that surficial geologic mapping for the Guevavi and Galabazas units doesn't likely exist. In a post-scoping conversation with Phil Pearthree, Stephanie O'Meara confirmed that surficial maps of these units don't exist.

Meg Weesner (NPS SAGU) asked for clarification regarding surficial versus bedrock geologic maps. Phil explained that surficial maps define the location of young, unconsolidated deposits. The GIS products that are a part of the GRE can produce separate layers for both surficial and bedrock geology, a capability that is missing from hard copies of geologic maps (Stephanie O'Meara). Each layer of the GIS map has more detail as a data layer.

Bob Casavant (AZGS) wanted to know if GRD would digitize a more detailed map if it were available. Don Swann (NPS SAGU) was also interested in this as he had found within files at Saguaro NP a detailed structural observations map containing strike and dip azimuths of minor

faults, foliation orientation, trend and plunge of structural related lineations and other similar structurally related observations. Don noted that there were two or three other similar studies that had been done by students relevant to Saguaro NP.

Stephanie explained that hundreds of observation localities present on this map would be captured (digitized) as points; however, this type of detailed map is typically not produced by the GRE. It just depended on the needs of the park. She further added that the purpose of the digital maps produced by the GRE was to be a baseline inventory for the resource manager. Jon Spencer (AZGS) explained that many of these detailed maps are more useful as a research tool than as a map for the resource managers. Stephanie noted that the maps don't usually get into the kind of detail found on the Don's fault map, but these maps should be in the bibliography and/or GRE report so they will become part of the reference list for the resource manager.

Andy Hubbard (NPS Sonoran Desert Network) requested both a bedrock and surficial map (depth to bedrock map?) to better understand the depth to bedrock and where groundwater might intersect the surface. Any product that would help define the hydrogeology of the area would be of great value to the park since water rights issues and water quality issues are becoming more prevalent. It is yet to be determined if the maps the GRE will produce for Tumacacori NHP, GMAPs 1487 and 7467, will prove useful for this purpose. It is unlikely that depth to bedrock information (e.g., well or borehole localities with this information) would be present as a GIS component of these maps. Literature concerning this topic likely exists, however. The NPS Water Resources Division (WRD) could be contacted regarding this matter.

GRE mapping action planned for FY 2006 includes:

- The GRE will acquire from the AZGS the following digital source: DGM-13 (GMAP 7467). This map covers in extent the Tumacacori unit, as well as the surrounding area. The GRE will evaluate and convert the digital data to the GRE geodatabase data model format. The GRE will also evaluate the bedrock component of this map and determine if additional bedrock maps or mapping is needed. Ancillary text and figures associated with the data source will also be acquired and formatted to the GRE format.
- The GRE will evaluate and digitize the Rio Rico quadrangle portion of USGS paper map I-762 (GMAP 1487) to the GRE geodatabase data model format. The Rio Rico quadrangle portion of the map covers in extent the Guevavi and Calabazas units, as well as the surrounding area. Ancillary text and figures associated with the map will also be acquired and formatted to the GRE format.
- The GRE will evaluate the need for surficial mapping of the Guevavi and Calabazas units. The AZGS would be the likely agency to conduct this mapping. At present, no ongoing surficial mapping is being conducted by the AZGS in the area. It will likely require funding by the GRE for this mapping to be undertaken.

## **Geologic Resource Management Issues**

The scoping session for Tumacacori National Historic Park provided the opportunity to develop a list of geologic features and processes, which will be further explained in the final GRE report. Geologic issues important to Tumacacori NHP management that carry relatively equal priority include:

- (1) Hazardous waste issues, and
- (2) Groundwater and surface water issues

### **Hazardous Waste Issues**

Leaking buried fuel tanks were discovered on property that was recently acquired by the NPS (Andy Hubbard). Soil and groundwater have been tested and the results are pending.

### **Groundwater and Surface Water Issues**

Surface water quality is a major issue at Tumacacori NHP (Andy Hubbard). Raw waste and garbage debris flows are present in Nogales Wash. The upstream International Wastewater Treatment Plant does not meet EPA regulations. Surface water and groundwater are interrelated because the bedrock is near the surface and so groundwater often intersects the surface topography.

The Mission Unit (350 acres) has the most issues, but the entire Santa Cruz River corridor is being considered as a National Heritage Area (Andy Hubbard). Asked if any cleanup action is in progress, Andy said there is but that it will be very expensive to upgrade the International Wastewater Treatment Plant. Whatever the plant can't process goes into the river. Aquatic and riparian endangered species (not specified) are present at the Mission Unit (Andy Hubbard).

Riparian wetlands (sloughs) along the river are not aerially extensive, but they are important for wildlife. They always contain water because the river has water from the wastewater treatment plant (Andy Hubbard).

An additional concern, although not a geological issue, is the power line that is being built just west of the park on National Forest Service land for the Tucson-Nogales area. The power line will impact the park's viewshed.

## **Features and Processes**

Tumacacori is part of the long-term Santa Cruz River incision (Phil Pearthree). The park is built on the margin of a historical floodplain and the deposits record a complex recent geologic history. The river corridor is constrained by topography.

Jeremy Moss (TUMA) acknowledged that both flooding and erosion are needed processes at Tumacacori. Processes, both past and present, within the Santa Cruz floodplain also often change the channel morphology of the river.

## Recommendations

- Map the distribution of surficial deposits including alluvial fans, debris flows, and different soil ages.
- Map each of the three units that comprise the park.
- Map the depth to bedrock to better understand the hydrogeology of the park and the interaction of groundwater with surface water.

## Action Items

No action items were discussed at the meeting.

**Table 2. Scoping Meeting Participants**

Name	Affiliation	Position	Phone	E-Mail
Allison, Lee	Geologist	Arizona Geol. Survey	520-770-3500	lee.Allison@azgs.az.gov
Casavant, Bob		Arizona State Parks /University of Arizona	520-626-3785	casavant@geo.arizona.edu
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